## REMARKS

Applicants' attorney is appreciative of the telephone conference with the Examiner held on July 20, 2009, in which inventor Peter Burton and applicants' Australian attorney Alistair Smith participated. During that telephone conference, the differences between the invention and the prior art were discussed in detail, and the Examiner recommended that Applicants submit additional evidence to further demonstrate the improvements offered by the present invention. Accordingly, the following discussion outlines the improvements of the invention, with reference to Exhibits supplied as attachments to this response, which provide supporting data and specific comparisons of properties of the invention compared to those of competitive products.

Claims 1-10 have been rejected under 35 USC 103(a) over Shaner et al (US 4,361,612) in view of Liu et al (US 2003/0064230) with evidence by Vinden et al (US 2003/0189039).

The Office Action alleges that Shaner et al discloses the features of independent claim 1, except for the hard wood being eucalypts and the binder including an isocyanate resin. Vinden et al has been cited as providing evidence identifying eucalypts as known hardwoods and that Liu et al has been cited as teaching using binders that may include an isocyanate resin.

However, Shaner et al itself was directed to solving the problem that hardwood species could not satisfactorily form well bonded particle boards. See, for example, the explanation in Shaner et al at col. 2, lines 19-34. The solution posed by Shaner et al is to use cross cut flakes up to six inches in length, with a thermosetting phenol/formaldehyde resin.

Liu et al teaches that preferred polymeric binders may include isocyanate resin and phenol formaldehyde (paragraph [0018]). Despite listing isocyanate resin as one of a number of preferred binder materials, Liu et al does not contain any

specific teaching towards using an isocyanate resin, as opposed to the phenol formaldehyde resin which is *required by* the process of Shaner et al.

Phenol formaldehyde is specifically discussed as being suitable for use in the technique as taught by Liu et al, and no negative effects resulting from the use of phenol formaldehyde are mentioned (paragraph [0019]). Furthermore, no specific benefits of using isocyanate resin are suggested by Liu et al, and a person skilled in the art may not have even appreciated that isocyanate resin even had separate application beyond the method of Liu et al, based on the disclosure.

In light of the above, there are no specific teachings in Liu et al to suggest any positive outcomes from modifying Shaner et al from the status quo of phenol formaldehyde, or even any suggestion that substituting an isocyanate resin in the method of Shaner et al would even work. Accordingly, Applicants submit that if a skilled person attempting to improve the method of Shaner et al consulted Liu et al, that person would <u>not</u> be motivated to change the resin material from phenol formaldehyde to isocyanate.

The Office Action has noted that Liu et al does not teach against using isocyanate resin and that there are numerous references that teach using isocyanate resin including Clarke et al. It has thus been asserted that this type of resin is a common resin in the wood strand art for bonding strands in boards. However, Applicants respectfully submits that although isocyanate resin may have been known at the time, this does not necessarily indicate that it was known to work with the type of lamina as described by Shaner et al, using mixed hardwoods.

Liu et al relates to strand boards with fire retardant properties, and Clarke et al relates to a strand board composite structure which will resist weathering and

delamination, the surface of which may be readily embossed with relatively deep patterns. In both Liu et al and Clarke et al, the other resulting structural and mechanical properties such as the strength and stiffness of the boards are a secondary consideration. Therefore, a skilled person would not assume that the teachings of Liu et al and Clarke et al could be appropriate for use in the production of high strength and stiffness structural boards such as those described by Shaner et al.

Applicants submits that a skilled person trying to improve Shaner et al for use in structural applications would desire to increase the structural mechanical properties such as the strength and stiffness of the board product. Since both Clarke et al and Liu et al describe board products with relatively low structural mechanical properties, Applicants submit that a skilled person would consider these documents to *teach away* from improving the structural mechanical properties of a board product in favor of other properties by using isocyanate resin.

Furthermore, Shaner et al describes the required characteristics of the phenol formaldehyde resins in very specific detail (col. 6 line 61 to col. 7 line 24). From the disclosure of Shaner et al it would be readily apparent to a skilled person that the use of phenol formaldehyde with the described characteristics is fundamental to the method of Shaner et al. It is submitted that a skilled person would therefore conclude that only very specific compositions of phenol formaldehyde would work in the method of Shaner et al, and due to the absence of any disclosed alternatives, that the use of other resins would not be suitable for the intended purpose of Shaner et al.

Accordingly, Applicants submit that a skilled person, upon reading the strict requirements for what constitutes a satisfactory phenol formaldehyde resin for use in Shaner et

al, would not have expected satisfactory results substituting for the resin of Shaner et al.

In the Examiner's answers to Applicants' arguments, the Examiner has interpreted isocyanate and phenolic resins as admitted alternatives for bonding strands in boards, as was disclosed in the originally filed application. At the time of filing, Applicants did believe that either resin could be used, although it is clearly stated in the original application that the preferred resin is an isocyanate binder (page 3, lines 24-29).

Following filing, ongoing testing by Applicants showed that phenolic resins could not satisfactorily bind the eucalypt strands, and that the performance of the resulting strand products was generally poor in comparison to those using isocyanate resins. For example, swell testing figures vary from 12% to 27% for eucalypt strand products using phenolic resin, compared to figures of 2% to 4% obtained for products using isocyanate resin (results will be discussed in more detail below), and the strength properties using phenolic resin were 30% to 40% below the results achievable using isocyanate resin. Given these results, Applicants removed the phenolic resin from the claims.

As mentioned in the Applicants' response to the previous Office Action, the process described by Shaner et al is not necessarily appropriate for use with every type of hardwood, and the mere fact that eucalypt is considered a hardwood does not mean that a skilled person would have automatically tried to substitute eucalypt in the process of Shaner et al. In light of the sheer number of hardwood varieties (which are generally defined as being obtained from any non-coniferous tree species), Applicants submit that it would not have been obvious to specifically try to substitute eucalypt as the hardwood used in Shaner et al.

As of 2001, the Siempelkamp R&D Centre in Germany (which

later produced the test results of Applicants' previous response) had never processed eucalypt species for strand based products. Siempelkamp advised Applicants that they did not know if it was even possible to press eucalypt strands into acceptable engineered wood products. At the time, Siempelkamp was the world's leading research center for engineered wood products based on strand technology. Applicants respectfully submit that if the engineers at Siempelkamp, having more than ordinary skill in the art, did not consider eucalypts to be applicable to engineered wood products, then it would not have been obvious for the person of ordinary skill to use eucalypts in an attempt to improve the Shaner et al product.

The Office Action has responded to the Applicant's arguments by stating that no evidence has been presented that Shaner et al as modified by the prior art would be *unsuitable* for its intended purpose, and that it would have been obvious that different hardwoods have different properties.

However, as discussed above, by requiring the use of a spefiic phenol formaldehyde resin, Shaner et al does teach a skilled person not to use an isocyanate as disclosed by Liu et al. Although isocyanate is known in the prior art, none of the other prior art references teaches that isocyanate would be suitable for a strand product *using mixed hardwoods* as taught by Shaner et al.

Since there is no evidence to suggest that either the substitution in Shaner et al of isocyanate in place of phenol formaldehyde or the substitution of eucalypts in place of the mixed southern hardwoods as described by Shaner et al would have resulted in a useful product if used individually, a skilled person would not have considered that a combined use of isocyanate and eucalypts could have resulted in a successful outcome.

Accordingly, Applicants submit that the cited prior art

taken as a whole does not suggest that the claimed combination of eucalypts and isocyanate resin would result in the unexpected and non-trivial improvements provided by the present invention (as described in detail in Applicants' previous response), and further, that a skilled person would not have tried such a combination in light of the teachings of the prior art and results of testing products with separate substitutions of the resin or wood.

It has further been alleged in the Office Action that Applicants' statement showing shorter cure times when using isocyanate resins provides motivation for using the resin of Liu et al. Applicants point out, however, that the shorter cure times as stated were not disclosed in the prior art and in fact constitute part of the unexpected and non-trivial results of using isocyanate resin in combination with eucalypts.

The Office Action has also indicated that the Applicants have not presented any evidence why one would *not* use eucalypts but rather provided further arguments why one would use eucalypts. Similarly, the Office Action alleges that "Applicant does not present any evidence that Shaner ('612) as modified by the prior art would be unsuitable for its intended purpose."

However, it is not the obligation of Applicants to present such evidence. If Applicants do present such evidence, then Applicants may argue that the cited art teaches against the invention, and the Examiner has not met his burden of establishing a *prima facie* case of obviousness. (Note here that Applicants have alleged that Shaner et al teaches away from the use of isocyanate binder.)

Alternatively, if Applicants assume *arguendo* that the Examiner has established a *prima facie* case of obviousness, Applicants may present evidence of unexpected results in

accordance with 37 CFR 1.132 to rebut that case of obviousness.

Applicants have indeed presented evidence that the use of eucalypts results in an improved product, specifically with regard to mechanical and swell properties. Nothing in the cited art suggests that such results will be obtained as a result of a substitution which was contrary to the teachings of Shaner et al.

Concerning the telephone conference of July 20, 2009, Applicants now present the following supplementary evidence in support of the patentablility of the claimed invention.

The alignment characteristics of the claimed product are specified in claim 7, which recites that at least 70% of the strands to be fully aligned. It has been found that a combination of the alignment of the strands and the density helps control the mechanical properties of the final product. It is submitted that the high degree of alignment of the strands in the invention further distinguishes the invention from the prior art and current competitor products.

Oriented strand board, or OSB, has been considered here as a competitor product of the invention, to enable comparison of the alignment qualities of the invention to the prior art. OSB is an engineered wood product formed by layering strands (flakes) of wood in specific orientations. Generally OSB is of a three layer type with the core at 90° to the outer surface. However, there is no specification in the standards for OSB regarding alignment. The standards only call for certain minimum performance properties.

Although the alignment properties of competitor products are not typically revealed in public documents, and can only be visibly observed in surface finish, some independent studies of alignment properties of commercial OSB panels have recently been performed, and the improved quality of the invention product over OSB panels can be readily seen in

comparison.

As an example, in a technical note published in the *Forest Products Journal*, June 2008 entitled "Analysis of strand characteristics and alignment of commercial OSB panels" (available at www.entrepreneur.com/tradejournals/article/181115603.html, and attached hereto as Exhibit A), Chen et al carried out a study to analyze the geometric characteristics and orientation of strands on the top surface of a commercial 12 ft by 24 ft OSB master panel. The results of the analysis showed that only 43 percent of measured strands were oriented within 20 degrees from the strength axis, indicating considerable room for improvement. It was also identified in the study that since the highest stresses occur at the farthest distance in a cross section from the neutral axis of a composite panel in bending, the alignment of strands at the surface layers helps the bending strength and stiffness of OSB.

This contemporary study indicates that competitor products on the market after the filing date of the present application continue to have relatively low alignment qualities compared to the invention. It is therefore submitted that the alignment qualities of the invention were not shown by the prior art before the filing date of the present application and are not present in modern competitive products; therefore the requirements that "at least 70% of the strands are fully aligned" represents a patentable distinction over the prior art.

In order to highlight the above distinction, a new independent claim 11 has been added to the application, reciting that "at least 70% of the strands are fully aligned," and Applicants submit that claim 11 is novel with respect to the prior art.

The product of the invention offers performance that is substantially better than alternative products, and examples

of the improved performance results are clearly described in the specification. However, the following discussion and accompanying supplementary evidence provides further data to demonstrate the marked improvements over competitor products, such as OSB.

The boil and swell properties shown by the claimed product are significantly higher than those of modern contemporary engineered wood product properties, and far different from the properties achieved by Shaner et al.

Applicants submit herewith the document "Composite Durability Testing Methods & Limitations" (Exhibit B) which shows the 24-hour swell numbers for some typical OSB and panel products. It can be readily observed that the OSB products performed poorly in swell tests, with results of 25% swell or more. This relatively low resistance to moisture of OSB products was discussed in the background of the present application, and is a problem that tends to limit the application of OSB products. Even plywood, which is a considerably more expensive product due to the requirement for relatively high grade logs, swells in excess of 5% in the same tests.

In contrast, the swell properties of the claimed invention can be seen in the submitted document "Boil and Swell Tests" (Exhibit C) which presents the results of swell tests performed in accordance with the EN 300-4 OSB standards. The relevant parts of the EN 300 OSB standards are presented in the document "OSB standards North America and Europe" (Exhibit D). The swelling values measured on the product of the invention were extremely low, ranging significantly below the maximum permitted value according to EN 300-4. At a board density of 750 $kg/m^3$ the swelling results after stabilization indicated a swell of 1.7%. The swell numbers achieved by the claimed product had never been seen before by the German test scientists, who initially suspected faulty data; however, the

swell numbers were repeated time after time in tests.

The document "ESL comparison to EN Standard" (Exhibit E) summarizes the performance of the claimed product against the EN 300-3 and EN 300-4 standard requirements for swell and internal bond, along with the structural performance measurements of modulus of elasticity and modulus of rupture. It is evident that the claimed product exceeds the standard in all of these areas.

Most manufacturers typically produce OSB to a local standard such as EN 300-4, which requires a maximum swell of 12%. This can be seen, for example, in the submitted document "Kronoply OSB Specification" (Exhibit F). As has been demonstrated, the performance of the claimed products exceeds that required by the standards, and by a significant margin. It is clear from the data that the excellent swell performance of the claimed product is not just an incremental improvement over the prior art, but a very large improvement that allows the claimed invention to significantly out-perform the competitor products. This represents an example of just one of the substantial improvements which came about as a result of the particular combination of substantially aligned strands of hardwood from eucalypts bonded together with isocyanate resin. It is submitted that these was no teaching in the prior art that such improved results would occur from the claimed invention, and that the results were truly unexpected.

Furthermore, Applicants submit that there was (and still is) no hardwood strand product available which offers the high level of structural performance provided by the claimed invention, combined with the substantially improved swell properties. In light of this, new claim 12 has been added, which recites a modulus of elasticity ≥ 14,000 N/mm$^2$ and a swell of less than 2% in a standard 24 hour moisture swell test. Applicants submit that no prior art products are able to provide the structural performance properties and swell test

performance as required by claim 12, and therefore claim 12 is novel over the prior art.

The document "Boil and Swell Tests" also presents the results of boil testing of the claimed product, performed to the EN 300-4 standard. This standard specifies a minimum property in the internal bond of OSB intended for use in humid conditions. Tensile strength (internal bond after boiling) is measured perpendicular to the plane of the panel using test pieces which have been immersed in boiling water (>100°C) over a period of 2 hours then dried and tested for properties.

The results show that the internal bond properties of the claimed product exceeded the requirements of the standard after the 2 hour boil test requirement. Shaner et al never attempted the boil test as it did not exist at that time. The test for retained internal bond disclosed by Shaner et al was using a benign vacuum test temperature of 150°F for 15 minutes. The boil test of the standard requires the samples to be boiled at 212°F for two hours, and is a far more stringent test for determining internal bond. Therefore the applicant submits that the internal bond results presented by Shaner et al are not comparable to the results for the claimed invention.

The structural performance properties of the claimed invention are also noticeably improved over competitor engineering wood products products. The submitted document "ESL Performance" (Exhibit G) shows the modulus of elasticity compared to a number of competing products and solid lumber, and the significantly improved performance can be readily observed. It should be noted that the performance actually exceeds that of selected solid lumbers.

Modulus of rupture is also a commonly used measure of structural performance. A graph from June 4, 2008, shown in the submitted "Board Properties MOR" (Exhibit H), shows that the claimed product has a modulus of rupture of 2.76 times

that of Kronoply OSB. This data provides further confirmation that the present invention product offers a significant improvement over a typical commercial OSB product.

As mentioned previously, the document "ESL comparison to EN Standard" (Exhibit E) also summarizes the performance of the claimed product against the EN 300-3 and EN 300-4 standards for modulus of elasticity and modulus of rupture, and the improved structural performance over that required by the standard can be clearly seen.

Further demonstrating that the structural performance of the claimed invention can exceed that of solid lumbers, "High Surface Soundness" (Exhibit I) shows the Brinell hardness of the claimed product in comparison to North American solid lumber. It can be seen that the claimed product has surface soundness that even exceeds that of Red Maple hardwood. The "Board Properties MOR" (Exhibit H) document also shows that the claimed product has an embedded fastening strength about 2.1 times that of Douglas Fir, which can take up to 10 times longer to grow prior to being harvested, compared to the species used to make the claimed product (tests were performed in May 2008).

The claimed invention has been able to achieve all of the high performance results discussed above using young growth plantation trees of the Bluegum (Eucalyptus Globulus) species. This subsequently allows for the sustainable production of high performance engineered wood products without the destruction of native hardwood forests. Competitor products typically rely on larger diameter trees and older trees, aged at least 30-40 years, and certainly not plantation trees aged between 8-12 years as described in the present application.

Since the claimed invention product can be formed from young Eucalyptus plantation trees, this opens an entirely new purpose for the existing Eucalyptus plantations. Eucalyptus plantation resources are now located in all the temperate

zones of the world with billions of dollars invested. The focus of the wood resource investment is for chipping for the pulp and paper industry. The claimed product offers a further high value added option for plantation owners. Plantations are the new direction in sourcing wood for engineered wood products as many countries beginning to restrict logging in native hardwood forests in Asia and South America, for example. The document "Plantation eucalypt resources" (Exhibit J) further discusses this growth area.

The document "Eucalyptus Log Supply Specifications" (Exhibit K) details the requirements for logs from which the claimed product can be made. It is apparent that logs with relatively small diameters may be used, and the log age needs to be only 8 years or more. This is in contrast with other competitor products in which performance approaching that of the claimed invention can only be attained through the use of larger and much older logs.

Eucalypt plantation based trees also provide long straight consistent logs, which allow the strands to have the fibers parallel to the strand edge. Many hardwood forest trees are prone to bends in the trunks causing the fibers to be curved to the strand edge, lowering the strength performance of the finished engineering word products even if the strands are well aligned in the mat by the formers. It can therefore be seen that there are additional process and performance benefits to using younger plantation trees, which have allowed for further improvements over the prior art.

A further point to note is that the performance results presented throughout this response, which related to the claimed product formed from young plantation trees, have shown significant improvements over competitor products, and some results even show improvements over the properties of solid lumber. In this respect, a product derived from young trees having performance equal to or exceeding the competitor

products using older trees is truly an unexpected and remarkable result, and could not have been predicted by a skilled person upon consulting the prior art at the time.

In light of the above, new claim 13 has also been added, which requires that the strands be formed from plantation trees having an age between 8 years and 12 years. This feature is disclosed between page 2, line 30 and page 3, line 1 of the specification. It is submitted that none of the prior art references discloses the use of plantation trees aged between 8-12 years, and therefore claim 13 is novel with respect to the prior art.

Withdrawal of this rejection is requested.

In view of the foregoing amendments and remarks, Applicants submit that the present application is now in condition for allowance. An early allowance of the application with amended claims is earnestly solicited.

Respectfully submitted,

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